APPLYING PESTICIDES EFFICIENTLY

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ABSTRACT

Pesticide manufacturers spend large amounts of time and money to determine the recommended application rate for pesticides. The recommended rate must be large enough to control the target pests under most field conditions, but must be as low as possible so use of the pesticide is as economical as possible for the farmer. The effect of pesticides are greatly influenced by the method and timing of application and the operation and accuracy of the equipment used. Applying too little pesticide causes ineffective pest control that may require the added expense of respraying. Applying too much pesticide adds to the cost, may damage the crop, and may lead to environmental pollution. Labels on pesticide containers indicate proper application rates. However, these rates can be achieved only if the application equipment is suitable for the job, calibrated frequently, and operated properly.

Achieving satisfactory results from pesticides depends heavily on five major factors:

1. Positive identification of the pest. Make sure you know which pest you're trying to control before filling the sprayer tank with pesticides.
2. Using the right pesticide. Choose a pesticide that will work.
3. Selecting the right equipment, and particularly the right type and size of nozzle for the job.
4. Applying pesticides accurately at the right time.
5. Maintaining spray equipment in good condition. Individual components of the equipment should be checked periodically to make sure that you are applying the amount recommended on the chemical label.

This article suggests techniques to achieve maximum accuracy and efficiency in liquid pesticide application

Guidelines for Effective Spraying

Once the pest is identified and a pesticide selected, the next step is to make sure the right equipment is available to apply the pesticide at the proper rate to

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achieve satisfactory pest control. Many types of equipment may be used for applying different pesticides. An applicator can choose the best equipment depending on **a)** the time of application (pre-emergence, post-emergence, pre-plant incorporated) **b)** the growth stage of the target sprayed (young crops vs. established crops), and **c)** the physical shape and size of vegetation dominant within the application site (field or vegetable crops, trees, shrubs, grass, etc.). The applicator must make the final decision on selection of application equipment, its maintenance, operation and calibration, all of which can significantly affect application of pesticides at recommended rates.

The only way to determine whether or not a sprayer is actually applying a chemical at the recommended rate is to calibrate the sprayer. Regulatory guidelines in the U.S. indicate that the application should be within 5% of the recommended label rate. Evaluation of 152 private and commercial pesticide applicators in Nebraska revealed that only one out of four farmers were applying pesticides within 5% of their estimated rate (Rider and Dickey, 1982). A follow-up field survey of 103 private pesticide applicators indicated that only 30% of the cooperators were applying herbicides within 5% of their intended application rate. Twenty-six percent of the cooperators over-applied herbicides during a single application, with an average cost due to misapplication of $3.11/ha (Grisso et al., 1989). A survey conducted in South Carolina indicated that nearly 85% of applicators applied pesticides with error rates greater than 10% when compared to intended rates (Wolak, 1989). Hofman and Hauck (1983) reported that only 11 of the 60 sprayers they calibrated in North Dakota were applying chemicals within 10% of what the operator predicted. Calibration clinics conducted in Iowa and Ohio revealed that only 20 percent of sprayers tested were capable of applying a tank-mix within $\pm$ 5% of the intended application rate (Ozkan, 1987). Similar findings were reported from calibration clinics conducted in Montana and Colorado.

Although the survey results are limited to a small number of states, the data indicate that pesticide application accuracy continues to be problem regardless of the geographic location, and efforts to educate pesticide applicators should continue.

How uniformly the chemical is deposited on the target is as important as the amount deposited. Non uniform coverage can result from simple reasons such as using misaligned or clogged nozzles, nozzles with different fan angles, or from variation in distance from the ground or target crop canopy across the boom. These common problems result in streaks, untreated areas, or over-application of chemicals.

Below is a brief summary of guidelines to follow to produce an effective spraying job.

* Make sure all vital parts of the sprayer are functioning properly. Check for leaks. Check to see if the framework of the sprayer is structurally strong and secured to its carrier.

* Use water that looks clean enough to drink. Most problems with sprayer operation can be traced to foreign material in the water. Debris clog screens and wear out nozzles and pumps. Filter any water pumped from ditches, ponds, or lakes before filling the tank.

* One application rate is not recommended for all application situations. For example, in orchard applications, different rates are recommended depending on the tree canopy density, or for soil applied herbicides, different rates are recommended depending on the soil type. Therefore, always read the pesticide label to determine the proper application rate for your specific need.

* Mix the chemical in sufficient liquid carrier to apply the recommended coverage uniformly over the sprayed area. You must to be able to calculate the exact amount of actual chemical required for the spray solution in order to satisfy the label requirement. That means you must to be able to understand and follow recommendations written on the label. The application rate of a product, given on the label, is always expressed in terms of amount of product per hectare. However, because tanks come in different sizes, it is the responsibility of the applicator to determine the amount of product to be added to a full sprayer tank of water. Label instructions can be confusing. Allow time to double-check your calculations.

  Here is an example of the type of tank mixing situations you will come across. You have a 400 liter tank, your application rate is 40 liters per hectare, and the pesticide rate recommended is 4 liters per hectare. Therefore you need to apply 4 liters of pesticide in 40 liters of tank mix. How much pesticide formulation should you put in this tank filled with water? The answer is 40 liters.

* For accuracy, you must know how much water the tank will hold. For example, a tank rated at 200 liters may actually hold 210 liters when slightly overfilled. The assumption that tank markings are accurate, in this example case, can cause a 5% under application of the active ingredient. Don't rely on the tank markings. Carefully measure how much the tank contains. This can be done either by using a flowmeter or by weighing the sprayer on a scale when the tank is empty and full, and then converting the difference in weight to liters of water.

* You need to check the performance of each sprayer component prior to mixing chemicals to make sure they are performing satisfactorily. Don't under-estimate the importance of a single component. For example, many applicators consider the importance of an agitator in pesticide application equipment. Insufficient agitation may be a big problem with large tanks. This problem is most serious when applying pesticides formulated as wettable powders. If there are "dead spots" or sharp corners in the tank then insufficient agitation may allow wettable powders to settle to the bottom of the tank. In other cases, dry pesticides may float on the surface for a long time before mixing uniformly throughout the tank. As a result, the mixture sprayed may contain varying amounts of active ingredient at different times during the spray operation causing some areas to receive excessive amounts of pesticides, while other areas receive inadequate amounts.

* Select nozzles that provide the desired droplet size, flow rate, and pattern. Mount nozzles securely into position.

* Periodically, observe the output pattern of the nozzles. Streaks in a pattern indicate foreign materials inside a nozzle. Remove and clean nozzles; use a soft brush for the tip and screen. Cleaning with a pin, a knife, or any other metallic object can completely change the spray pattern produced by the tip.

Even if you have an accurate pressure gauge, the pressure reading at the gauge usually indicates pressure at the pump not at the nozzle. Always use a second pressure gauge to check the pressure at the nozzle so you can determine the pressure drop between the pump and the nozzles. There will always be some pressure drop in the supply line, but you should reduce it to minimum. Some factors that cause excessive pressure drop in the system include: a)a sprayer equipped with hoses of the wrong size (the suction hose should always be larger than hoses carrying spray mixture from pump to nozzles), b) supplying tank mixture to one end of the boom; liquid pressure will decrease along the length of the boom (use amanifold to distribute the spray mixture evenly to several boom sections), c) restricting flow by choosing a fitting that has a large inlet orifice but an outlet diameter that is too small.

* Small droplets usually are more efficient in controlling pests because they produce more uniform coverage on the target, and better deposition on the underside of plant leaves. Therefore, nozzles that produce small droplets are preferred when applying insecticides, fungicides, and contact herbicides. However, keep in mind the drift potential of small droplets. They have a tendency to be carried long distances by the wind before depositing. Spray drift should be avoided as much as possible because it results in wasted chemicals and may cause damage to plants, animals, or people adjacent to the sprayed area. Proper selection of application equipment, pesticide formulation, nozzle size and type, and operating pressure and spraying under favorable weather conditions significantly affect the degree of spray drift produced. Avoid spraying when strong winds are present.

* Operate the tractor at a uniform speed to ensure uniform application. There is an inverse relationship between the application rate and the travel speed. For example, doubling the travel speed of a sprayer reduces the application rate by one-half; conversely, halving the travel speed doubles the application rate. Another way to express the influence of travel speed is misapplication rate. A sprayer traveling at 4 km/hr that deviates 1 km/hr would result in a 25% misapplication rate.
Several factors could cause your travel speed to vary. One of the most obvious factors is tire slippage, which may vary from field to field. Therefore, measure sprayer travel speed in the field where you will be spraying. Do not rely on the tachometer or speedometer on the tractor. They are often not accurate enough for your application requirements. A tractor's tachometer is

an excellent instrument for indicating how fast the engine's crankshaft, or rear wheels are turning. But it is not an accurate measure of true ground speed. If, for example, your tachometer ground speed markings were established at a tire pressure of 80 kPa and current tire pressure is only 60 kPa, the tire will now have a smaller rolling radius. Consequently, the tractor will travel at a slower speed than the tachometer indicates. The result will be overapplication of chemicals.

* The only way to determine whether or not a sprayer is actually applying a tank mixutre at the recommended rate is to calibrate the sprayer. The difference between actual sprayer application rate and intended rate should not be more than 5% of the intended rate. Always calibrate the sprayer for application of the exact amount of chemical needed. The flow rate of nozzles, especially those made from brass, increase as they become worn. Therefore, calibrate your sprayer as often as possible.

* Pay attention to uniformity of spray coverage on the target. Spraying the right amount of pesticide on the target is not enough to achieve effective pest control. How uniformly pesticide is deposited on the spray target may be as important as the amount deposited. Each nozzle produces a unique spray pattern. Some nozzles require precise overlapping of patterns from adjacent nozzles. Improper boom height, clogged nozzles, misaligned nozzles spraying at different angles, and using nozzles with different spray angles are some of the most important factors that contribute to non-uniform coverage.

* Maintain the sprayer in good operating condition by periodic inspection and repair. Carry extra nozzles, washers, other spare parts, and tools for quick repairs in the field. Do not run the pump without liquid in the tank.

* Read the sprayer operator's manual and chemical labels to review recommended procedures for safe use of chemicals and the equipment. Wear protective clothing when calibrating, spraying, and cleaning equipment. Goggles, rubber gloves, and respirators or masks are standard equipment when handling pesticides.

Conclusion

Now, more than ever before, applicators need to do a better job of applying pesticides because pesticides used today are more potent and require more precise placement. An applicator has to consider at least the six major factors we discussed previously to achieve best results from a pesticide application. These factors are: 1) know the exact volume of the tank, 2) carefully calculate how much pesticide to add to the tank, 3) measure ground speed, 4) consider the influence of soil type and soil conditions on the amount of pesticide needed, 5) make sure the pressure gauge is working properly, and 6) calibrate the sprayer and make sure the coverage across the field is uniform.

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